[*From the Journal of Physiology. Vol. V. No.* 1.]

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ON RHYTHMIC CONTRACTION OF THE CAPILLARIES IN MAN. By T. LAUDER BRUNTON, M.D., F.R.S.

RHYTHMICAL contraction and dilatation of the small blood-vessels independently of the action of the heart were first observed by Wharton Jones in the veins of the bat's wing[1]: and next by Schiff in the arteries of the rabbit's ear. A similar occurrence was observed by Cohnhein and Gunning in the web and tongue of the frog, and by Ludwig and myself[2] in all the arterial twigs of the subcutaneous connective tissue. Ludwig and his pupils, Sadler and others, have also found such variations in the flow of blood through excised muscles as can hardly be explained in any other way than by supposing that the muscular vessels have a rhythmical contractility.

Rhythmical pulsation of the vena cava and pulmonary vein was observed by Fayrer and myself in the rabbit; and although this fact was known to Haller and others, it was not to be found in modern text-books.

Rhythmical contractile power therefore seems to be a quality common to all the blood-vessels in the body; and indeed this property belongs to involuntary muscular fibre generally.

The rhythm varies very greatly in its regularity, and its occurrence seems, to a great extent, to depend upon the application of some external stimulus. Romanes observed that the rhythmical contraction of the bells in Medusa ceased when the ganglia were all removed, but recommenced on the application of some stimulus, such as a little acid added to the water in which the bell was immersed. In the case of involuntary muscular fibre, mechanical distension seems to have a similar effect in stimulating rhythm. Ludwig and Luchsinger have shown that the tension inside the heart is a powerful stimulus to its rhythm[3].

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[1] *Philosophical Transactions*, 1852, page 131.

[2] Ludwig's *Arbeiten*, 1869.

[3] Ludwig und Luchsinger, Pflüger's *Archiv*, Bd. 25, 1881.

Luchsinger found that when artificial circulation was kept up in the bat's wing distinct pulsation could be observed in the veins 20 hours after the animal's death. If the pressure of blood was allowed to sink to zero, the pulsation stopped, but recommenced when the pressure was again raised to 40 or 50 centimetres of water[1].

This experiment appears to show conclusively that the rhythmical pulsation in these vessels is a function of the involuntary muscular fibre composing their walls, and not of the nervous system, because the central nervous system has completely lost its function, and it is unlikely that the peripheral nerves would retain any independent action on the vessels so long after somatic death.

I am not aware that rhythmical contraction and dilatation of the capillaries independently of the heart and respiration has hitherto been described in man. I think I have seen somewhere an observation that the hectic flush on the cheek has been noticed to grow larger and smaller, but this might be nothing more than dilatation and contraction of the vessels coincident with the pulsations of the heart or with the movements of respiration. The cases in which I have observed rhythmical pulsation independent of the heart and of the respiratory movements were cases of marked aortic regurgitation. When the aortic valves are incompetent the blood flows back into the heart during the diastole, leaving the pressure in the arterial system low. The heart thus receives during diastole blood from two sources, from the pulmonary veins and from the aorta; so that at the next systole a very large wave is forcibly driven into the relaxed aortic system. This not only gives rise to the water-hammer pulse described by Corrigan, but the alternate distension and relaxation of the small arteries render pulsation in them much more readily observed than in ordinary cases.

The method of observing it is this. The finger-nail should be drawn once or twice up and down the middle of the forehead; a red streak is left, which will sometimes remain for many minutes. This streak undergoes variations of width and brightness which are very evident to the eye, and some of which coincide with the beats of the heart. In some cases the pulsation is so evident that the pulse of a patient can be counted with ease at a distance of five or six feet, or more. I do not know to whom this method of observation is due. I first learnt it several years ago from Dr Dreschfeld, who informs me that he saw it in Gerhardt's *Auscultation und Percussion*, Tübingen, 1876, 3rd edition, page 69.

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[1] Luchsinger, Pflüger's *Archiv*, Bd. 26, page 452.

Capillary pulsation coincident with the beats of the heart was, as far as I am aware, first noticed by Lebert[1] in a case of aortic aneurism, and it was shown by Quincke[2] to occur in healthy persons but to be specially well marked in cases of aortic regurgitation.

In the red streak just mentioned it is quite easy to observe in addition to the visible pulse corresponding to the cardiac beat, a second rhythm of contraction and dilatation corresponding to the respiratory movements, and the rate of which is about 18 per minute or one-fourth the rapidity of the cardiac pulsations.

But in addition to those two rhythms it appears to me that there is a third, which I am inclined to regard as due to independent contraction of the minute vessels and corresponding to the rhythmical pulsations already described as occurring in the lower animals.

On account of the difficulty of seizing the exact moment at which the red streak attains its greatest and least breadth, and on account of the interference of the cardiac and respiratory rhythms, it is difficult to ascertain precisely the rate of the capillary rhythm. From a number of observations, however, I think one may state that it usually occurs approximately at the rate of 1 in 20 seconds, so that the respiratory rhythm is about six times as rapid, and that of the pulse 24 times as rapid as that of the capillaries. It is probable, however, that this rate is subject to numerous variations: and indeed in a case that I observed a short time ago, capillary pulsation occurred once in about 10 seconds, or at nearly double the rate which I have usually observed on other occasions.

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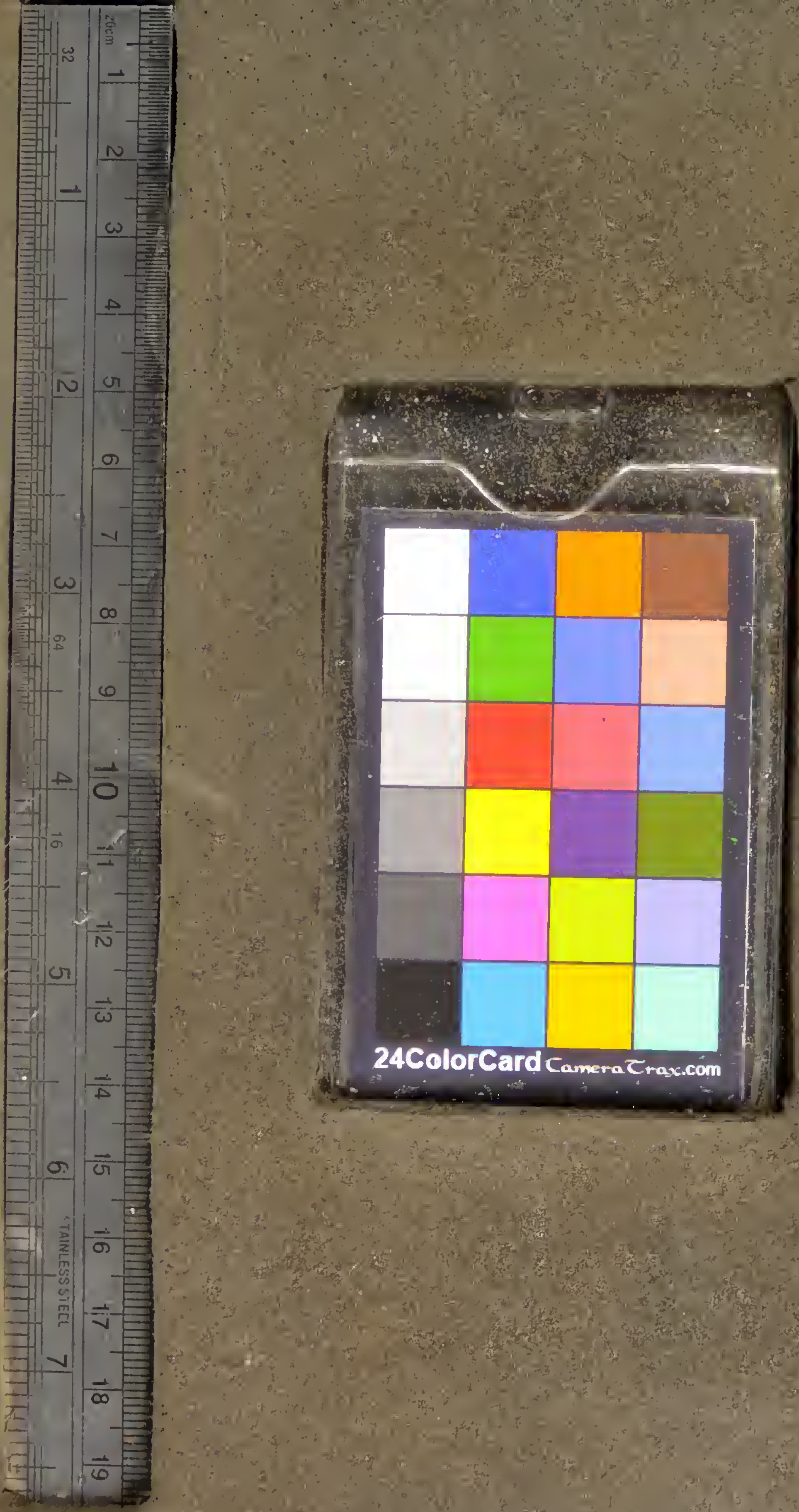
[1] Lebert, Virchow's *Handbuch d. sp. Path. u. Therap.* Bd. v. Abt. II. Lfg. 2. 2te Aufl. 1867, page 390.

[2] Quincke. *Berlin. klin. Wochenschr.* No. 34. 1868.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